High Intensity Interval Training

Why You MUST Use Intervals

- Interval Training increases total WORK performed at higher intensity resulting in:
  - Faster improvement in VO2 Max
  - Greater adaptation of Type II Muscle Fibers
  - Increased Lactate & Ventilatory Thresholds
  - Increased Weight Loss

High Intensity Intervals

- Tabata (1996)
  - 6 weeks Training Study
  - Continuous: 5 days/wk; 70% VO_2; 60 min.
  - H.I.I.T. 4 days/wk; 20 sec. work (170%VO_2max), 10 sec. rest; 7-8 sets; 1 day/wk-70% VO2; 30 min.
- H.I.I.T.
  - ↑ VO_2 7ml/kg/min and Anaerobic Performance 28%
  - Continuous VO_2 ↑ 5ml/kg/min Anaerobic 0%

Intervals Increase Weight Loss By:

- Increases Total Calorie Expenditure During the Workout
- Increases Fat Utilization both During and After Exercise
- Increases Excess Post-Exercise Oxygen Consumption (E.P.O.C.) – The Afterburn

What is E.P.O.C.?

- O_2 Consumption Necessary to Return to the Pre-Exercise Physiological Resting State
  - Replacing oxygen stores,
  - Phosphagen (ATP-PC) resynthesis,
  - Lactate removal, and
  - The increased ventilation, blood circulation and body temperature above pre-exercise levels

Expend More Calories at REST

- Studies have shown increases of additional 10-160 kcals over the course of 24 hours

Enhancing EPOC

- Studies show that EPOC is dependent on both the intensity and duration of exercise
  - Bahr and Sejersted (1991)
  - Smith and McNaughton (1993)
  - Phelian et al. (1997)

Impact of Training Status & Gender

- Gender
  - Smith and McNaughton (1993)
    - 30 minutes at 70% VO2Max
    - Men – 141 kcal; Women – 122 kcal
  - Increased Lipoprotein Lipase (LPL) activity in Men but not Women

- Training Status
  - EPOC is reduced in highly trained persons
  - Endurance Athletes can increase VO_2max by using interval training

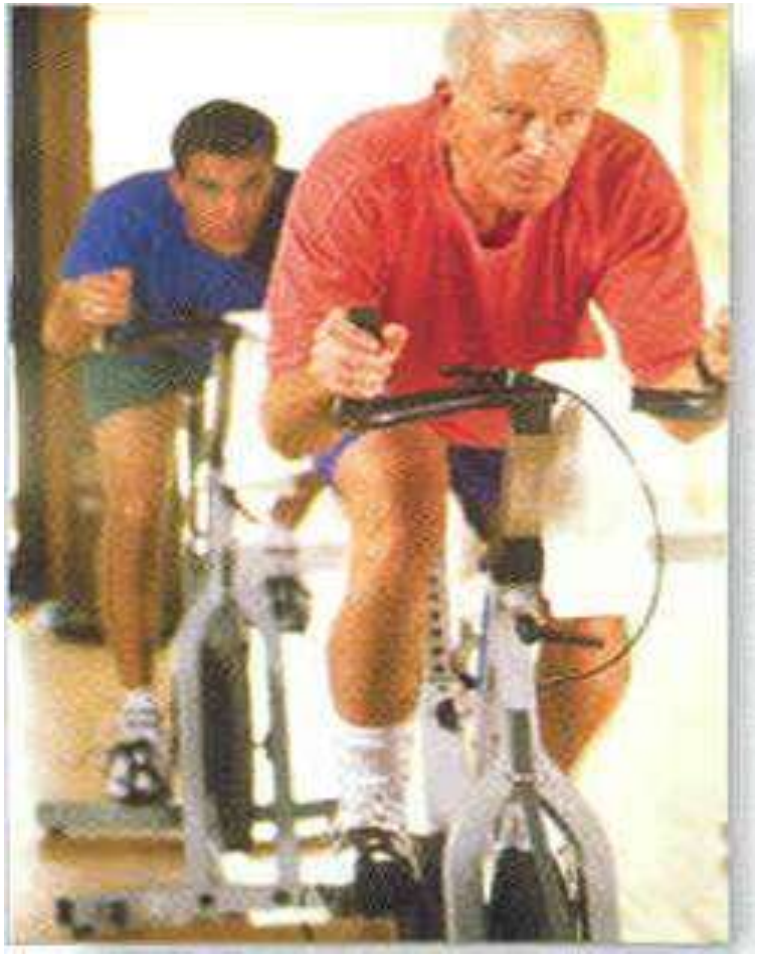
DESIGNING INTERVAL PROGRAMS

- Training Variables
  - Work
  - Rest/Recovery
  - Cycles/Repetitions
  - Sets

WORK

- Exercise performed at a higher intensity
- Time & Intensity factors
  - Client's goals, motivation, fitness level, health, and energy system you want to challenge (sport-specific)
- The higher the intensity the shorter the work interval

REST/RECOVERY



- Lower intensity
- The higher the work intensity, the longer the rest
- Active
- Passive

CYCLES/REPETITIONS

- Refers to a complete work/rest interval
- Similar to a repetition in weight training
- Can be repeated 1-20 times

SETS

- The number of times a series of cycles will be performed in a given exercise session
- A longer rest period is given between sets

Programming Intervals Based on Energy Demands

- Phosphagen System
- Glycogen System
- Aerobic System

Phosphagen System

Substrate	Stored ATP/CP
Duration	< 30 sec.
Intensity	95% - 100% Max
Examples	100 meter sprint; power lifting
Evaluation	Vertical Jump

Glycogen/Lactic Acid System

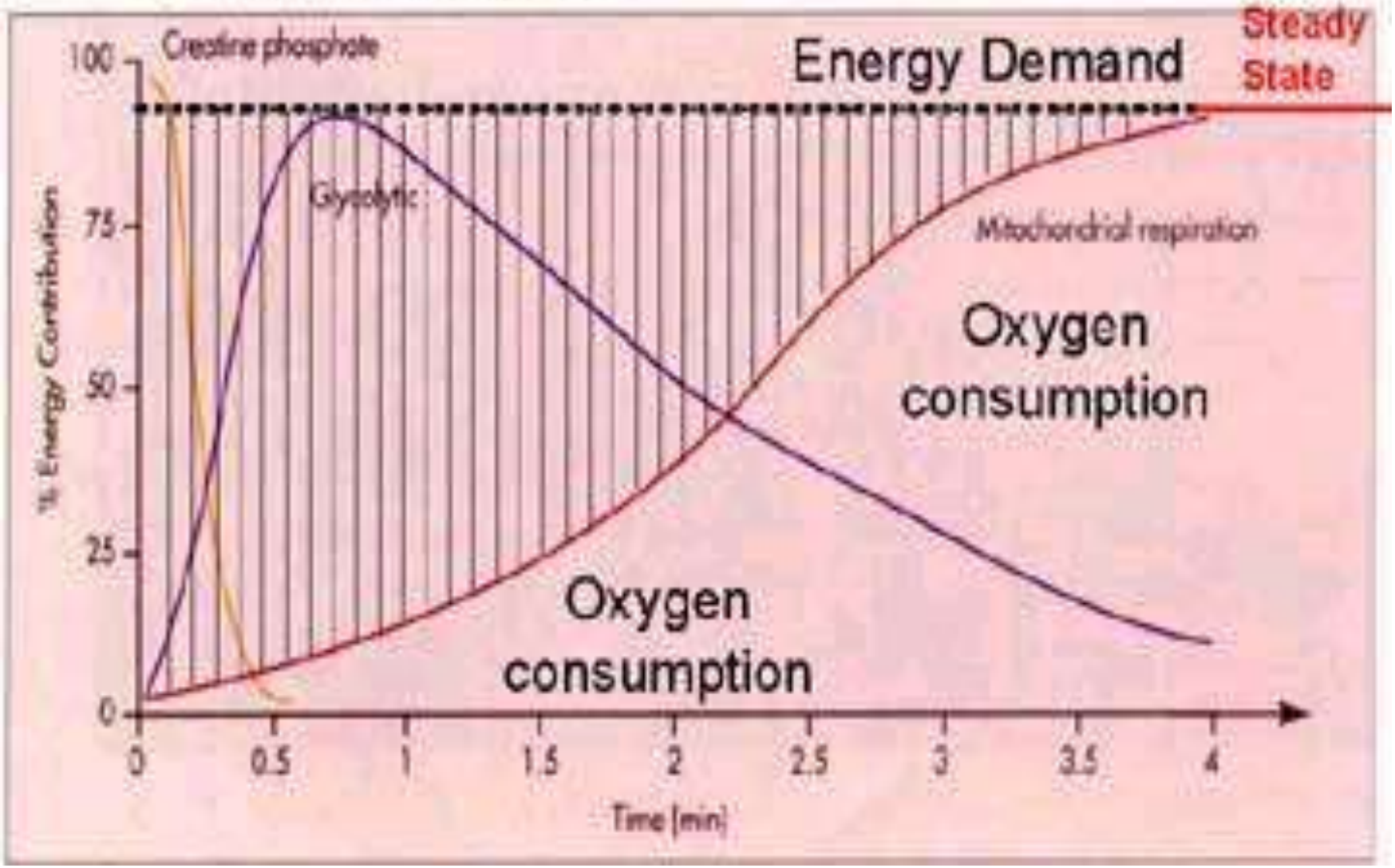
Substrate	Glucose, glycogen
Duration	30 sec. –3 min.
Intensity	85% - 95% Max
Examples	400-800 meter run
Evaluation	300-Yard Shuttle Run

Aerobic System

Substrate	Glucose, glycogen, fatty acids, amino acids
Duration	> 3 min.
Intensity	< 85% Max
Examples	>1500 m run, > 3000 m cycling
Evaluation	1.5 Mile Run

System	Work	Rest/Type	Reps	Sets
ATP/PC (Strength & Power)	0-30 sec	0-90 sec Passive	8-10	4-5
Glycogen (Speed)	30-60 sec 60-120 sec	90-180 sec Active/Passive 120-240 sec Active	5 5	3-4 2-3
Aerobic (endurance)	2-3 min 3-5 min	2-6 min/Active 1 ½ -5 min. Active/Passive	4-6 3-6	1-2 1

Start of exercise



Thresholds in Interval Training

- Anaerobic Threshold
- Lactate Threshold
- Ventilatory Threshold

Anaerobic vs. Lactate Threshold

- Anaerobic Threshold
  - point at which energy demand shifts from aerobic to anaerobic
- Lactate Threshold
  - The intensity of exercise at which there is an abrupt increase in blood lactate levels
    - 80-90% HRR in trained individuals
    - 50-60% HRR in untrained individuals
    - 13 to 15 on the RPE scale
    - ‘somewhat hard’ and ‘hard’

Ventilatory Threshold

- The point where ventilation deviates from the progressive linear increase
- Breathing becomes labored beyond the Ventilatory Threshold

Psychology of Interval Training

- Interval Training creates significant distress especially for untrained individuals
  - Excessive Lactate and H+ Accumulation
  - Respiratory Difficulty
  - Core Temp increases triggering cooling mechanisms (i.e. sweating)
- Intensity and Duration selection must meet the psychological preparedness of the individual

Measuring Intensity

- Max Heart Rate:
  - 220 – Age
- Max Heart Rate 40+:
  - 207 – (Age x .7)
- Heart Rate Reserve:
  - HRmax – RHR

Heart Rate Zone Training

- Zone 1: 50-60%:
  - Heart Healthy
- Zone 2: 60-70%:
  - Fitness or Fat Burning
- Zone 3: 70-80%
  - Aerobic or Endurance
- Zone 4: 80-90%
  - Anaerobic or Performance
- Zone 5: 90-100%
  - Red Line or Maximum Effort

Example

50 year old female; RHR: 66

- Max HR:
  - 220 – 50 = 170
  - 170 * Zone 2 = 102-119
- Max HR 40+:
  - 207 - (50 * .7) = 172
  - 172 * Zone 2
  - 60% = 104
  - 70% = 121
- HRR:
  - 170 – 66 = 104
  - 104 * Zone 2 = 62.4/72.8
  - 62.4 + 66 = 128
  - 72.8 + 66 = 139

Perceived Exertion

- Borg's Rating of Perceive Exertion or RPE Scale
  - 6 to 20
- Common Perceived Exertion
  - 0.5 to 10

Beginner Interval Program

- By Perceived Exertion
  - -5-7 min. warm-up
  - -5 min. run
  - -5 min. walk
  - -Repeat 3x's
  - -5-7 min. cool-down
- By Heart Rate Zone
  - -5-7 min. warm-up
  - -1 min. Zone 3
  - -2 min. Zone 2
  - -Repeat 5x's
  - -5-7 min. cool-down

Karp, J. (2000). NSCA Strength & Conditioning Journal. *Interval Training for the Fitness Professional. 22 (4), 64-69*

Sample Treadmill Program

week	***work***	***rest***	***cycles***
1-2	3 mph; 1 min	2.5 mph; 3 min	10
3-4	3 mph; 90 sec	2.5 mph; 2 ½ min	10
5-6	3 mph; 2 min	2.5 mph; 2 min	10
7-8	3.0 mph; 2 ½ min	2.5 mph; 90 sec	10
9-10	3 mph; 3 min	2.5 mph; 1 min	10
11-12	3 mph; 3 ½ min	2.5 mph; 30 sec	10

Intermediate Interval Program

- By Heart Rate Zone
  - -5-7 min. warm-up
  - -2 min. Zone 4
  - -3 min. Zone 2
  - -Repeat 5x's
  - -5-7 min. cool-down
- By Perceived Exertion
  - -5 min. warm-up
  - -10 min. run
  - -5 min. walk
  - -Repeat 2x's
  - -5 min. cool-down

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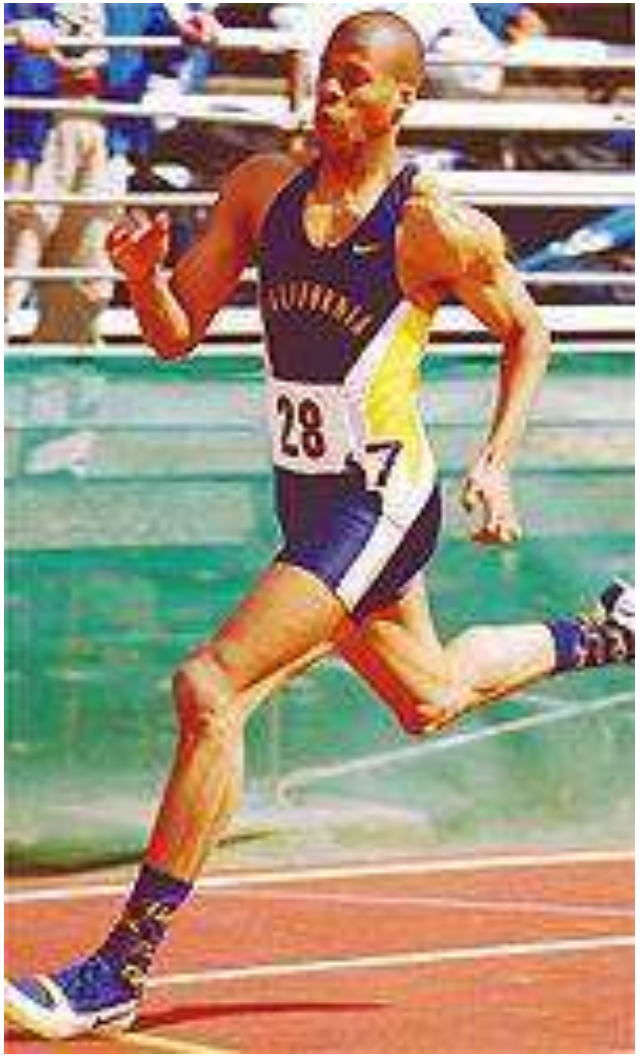
Treadmill Intervals

- Incline Training
- Recovery
  - Comfortable Speed 3 min.; 0 % grade
- Work Interval
  - Same Speed
  - 2% grade for 1 minute
  - 4% grade for 1 minute
  - 6% grade for 1 minute

- Speed Training
- Recovery
  - Comfortable Speed 3 min.; 0 % grade
- Work Interval
  - Same Grade
  - ↑ speed 1/2 mph 1 min
  - ↑ speed 1/2 mph 1 min
  - ↑ speed 1/2 mph 1 min

Intermediate/Advanced Intervals

- Cardiovascular Endurance
  - Stimulate greater gains in VO_2max b/c training allows for more time spent at VO_2max
- Sprint
  - Increase speed and anaerobic metabolism



Cardiovascular Endurance

- Competitive Runners/Cyclists, etc.
  - Warm-Up 5-7 minutes
  - Work Interval:
    - 4 minutes at 90-95% (Zone 5)
  - Recovery Interval:
    - 3 minutes at 50-70% (Zone 1 / 2)
    - Until HR <120bpm; ½ distance/time of work int.
  - Repeat 4-6 times
  - Cool-Down 5-7 minutes

Programming Advice

- Novice athletes/clients should train mostly EASY
- For intermediate to advanced athletes/clients
  - 2-3 times per week
  - <8-10% of total weekly mileage OR exercise time
  - Cut back Intervals during competitive season
  - Adjust interval pace for factors such as heat, humidity, altitude, headwinds, pollen count, etc.
  - Allow for 48 hours rest between interval sessions

Cardio Interval Variations

- Pyramids/Ladders
  - Systematically increasing the time or distance of the work and rest intervals
- Mixed Intervals
  - Varying the time or distance with each subsequent work/rest interval
- Pick-Ups
  - Increase speed for 10-30 seconds at regular or irregular intervals

Example: Pyramids or Ladders

Zone	Distance	Rest	Time	Rest
5	200 M	200 M	30 s	30 s
5	400 M	400 M	90 s	90 s
5	800 M	400 M	3 min	90 s
4	1200 M	600 M	6 min	3 min
4	1600 M	800 M	8 min	4 min

- Repeat in Descending Order
- Every 400 M = ¼ mile

Example: Mixed Intervals

Zone	Distance	Rest	Time	Rest
5	800 M	300 M	3 min	60 s
5	300 M	200 M	60 s	40 s
4	1200 M	400 M	6 min	2.5 min
5	600 M	200 M	2.5 min	40 s min
4	1600M	600M	8 min	2.5 min

Pick-Ups to Increase 10K Speed

Week	Work/Rest
1-2	Increase speed for 30 sec. at minute 10, 20, 30, 40
3-4	Increase speed for 30 sec. at minute 8, 16, 24...
5-6	Increase speed for 30 sec. at minute 6, 12, 18...
7-8	Increase speed for 30 sec. at minute 4, 8, 12…
9-10	Increase speed for 30 sec. minute 3, 6, 9…
11-12	Increase speed for 30 sec. at minute 2, 4, 6…

Go With the Flow

- Fartlek training
  - Work/Rest Interval durations and intensity are dependent on subjective monitoring of intensity
  - Work as hard as you feel motivated to
  - Rest as long as you need to

Suggested Race Training Intervals

Race Distance	Interval Distance
5K	200-800M
10K	400-1200M
½ Marathon	400-2000M
Marathon	800-3200M

Sprint/Metabolic Intervals

- Total Workout Time: <40 minutes
  - Warm-up 5-7 minutes
  - Work Interval:
    - Sprint 30 sec (95%+; Run/Cycle for your life!)
  - Recovery Interval:
    - Passive 90 sec
  - Repeat 8 times
  - Rest 3-5 minutes and Complete 2nd Set
  - Cool-Down 5-7 minutes

Sprint Intervals

- Effective for 5K/10K Distances or Less
  - 400m, 200m, 100m, 50m
- Add 6 x 200m light Sprints to end of a Tempo workout OR Cardio Interval Program

Example: Sprinter/Track Program

- Sprint Intervals:
  - Set 1-4 x 220 yds
  - Set 2-8 x 110 yds
  - Set 3-8 x 110 yds
- Accelerations:
  - Jog 50-120 yds
  - Sprint 50-120 yds
  - Walk 50-120 yds

Group Fitness Intervals

- Adding Intensity
  - Increase movement speed
  - Add traveling moves
  - Increase ROM, use longer levers
  - Add propulsions

GROUP FIT: AEROBIC INTERVAL

Type	Intensity % HRR	Time
Work-high/low Aerobics/step	> 75% RPE 14 – 16	3 – 4 minutes
Rest-low impact Aerobics/step	60 – 70 % RPE 12 - 13	3 – 4 minutes

GROUP FIT: ANAEROBIC INTERVAL

Type	Intensity % HRR	Time
Work-power step/aerobics	> 80% RPE 14 – 18	60 – 90 sec.
Rest-aerobic/step	60 – 70% RPE 12 - 13	3 minute

DON’T MAKE THIS MISTAKE!

- Some instructors and participants may be accustomed to or mistakenly desire continuously high work intensities
- Incomplete or inadequate rest limits the peak intensity of the subsequent intervals

GROUP TRAINING CIRCUIT

Station 1 Lateral Hops Over Step	**Station 2** Push Ups	**Station 3** Band Squats
Station 4 Leg Raises	**Station 5** Rope Jumping	**Station 6** Inverted Pull-Ups or Alternating DB Rows
Station 7 Mountain Climbers	**Station 8** Tubing Triceps Pressdown	**Station 9** Bridge Marching
•Instructor determines time spent and rest between stations •After 1 complete Circuit, rest 3-5 minutes •Repeat 1 to 2 times		

Resistance Training Intervals

- Tabata Method
  - Barbell or Dumbbell Squats
  - Using 25-40% of 1RM
  - 8 reps followed by 10 sec rest
  - Repeat for 4 minutes
  - STOP Workout!!!
- Not for the weak of heart OR mind
- DO NOT attempt with heavier resistance

Hybrid Intervals/Complexes

- Complex 1
  - Kettlebell Swings
  - Squat-Thrust w/ Max Push-Ups
  - Sprint 50 yards
- Complex 2
  - Squat Jumps
  - Max Pull-Ups
  - Jog 400 m